IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of Eiju SUZUKI, et al.
Application No.: 10/562,947
Filed: December 30, 2005
For: RUBBER COMPOSITION AND TIRE USING THE SAME
Group Art Unit: 1791
Examiner: Justin R. Fischer
Confirmation No.: 8599

DECLARATION UNDER 37 C.F.R. § 1.132

I, Eiju Suzuki, declare that:

I am one of the inventors of the above-captioned patent application.

I received my Master of Science and Technology from Keio University in 2002, and have been employed by Bridgestone Corporation since 2002, where I have been engaged mainly in research and development of new polymers.

I have made the following experiments in order to evaluate the processability, the wear resistance and the durability of the rubber composition comprising as a rubber component (A) a synthetic polyisoprene rubber having a cis-1,4-bond content of more than 99.0% and a 3,4-bond content of less than 0.5% (Polyisoprene rubber A), having a cis-1,4-bond content of less than 99.0% and a 3,4-bond content of more than 0.5% (Polyisoprene rubber B) or having a cis-1,4-bond content of more than 99.0% and a 3,4-bond content of more than 0.5% (Polyisoprene rubber C) and (B) a natural rubber, wherein a ratio by mass of (A) the synthetic polyisoprene rubber to a total of (A) the synthetic polyisoprene rubber and (B) the natural rubber is 5-60 mass%.

Experimental Procedure

<Preparation of Rubber composition>

(Additional Examples A and B)

By using the Polyisoprene rubber A prepared through the method described in paragraph [0028] in the specification of the present application, a rubber composition is prepared according

to a compounding recipe shown in the following Table C.

(Additional Comparative Examples F and H)

By using the Polyisoprene rubber C prepared through the method described in my previous declaration filed on January 13, 2010, a rubber composition is prepared according to a compounding recipe shown in the following Table C.

(Additional Comparative Examples G and I)

By using the Polyisoprene rubber B (IR2200, made by JSR Corporation), a rubber composition is prepared according to a compounding recipe shown in the following Table C.

<Evaluation of properties of rubber composition>

With respect to the resulting rubber compositions, the processability, wear resistance and durability of the rubber composition are evaluated according to the methods described in paragraphs [0032]-[0034] in the specification of the present application. Results obtained from these experiments are summarized in the following Table C.

Table C

			Additional Example A	Additional Comparative Example F	Additional Comparative Example G	Additional Example B	Additional Comparative Example H	Additional Comparative Example I	Comparative Example 6
Formulation	Natural rubber (RSS#3)	parts by mass	95	95	95	40	40	40	100
	Polyisoprene rubber A *1		5	-	-	60	-	-	-
	Polyisoprene rubber B *2		-	-	5	-	-	60	-
	Polyisoprene rubber C *3		-	5	-	-	60	-	-
	Carbon black *4		50	50	50	50	50	50	50
	Stearic acid		2	2	2	2	2	2	2
	Antioxidant 6C *5		1	1	1	1	1	1	1
	Zinc oxide		3	3	3	3	3	3	3
	Vulcanization accelerator DZ *6		0.8	0.8	0.8	0.8	0.8	0.8	0.8
	Sulfur		1	1	1	1	1	1	1
Evaluation	Processablity	index	108	104	103	140	124	117	100
	Wear resistance		101	100	100	98	94	91	100
	Durability		97	94	93	90	82	77	100

*1 Produced by the Production Example 1 of Polyisoprene described in paragraph [0028] in the specification of the present application, cis-1,4-bond content=99.6%, 3,4-bond content=0.4%.

*2 IR2200, made by JSR Corporation, cis-1,4-bond content=98.0%, 3,4-bond content=2.0%.

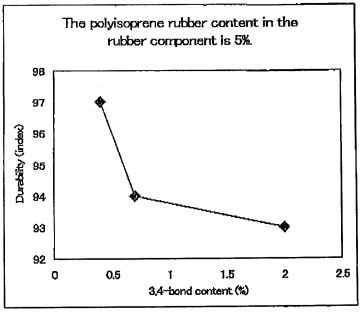
*3 Produced through the method described in my declaration filed on January 13, 2010, cis-1,4-bond content=99.3%, 3,4-bond content=0.7%.

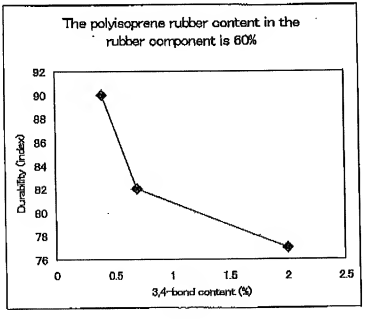
*4 N339, made by Tokai Carbon Co., Ltd. $N_2SA=93m^2/g$.

*5 N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine, made by Ohuchi Shinkou Kagaku Co., Ltd., Nocrac 6C.

*6 N,N'-dicyclohexyl-2-benzothiazolyl sulfenamide, made by Ohuchi Shinkou Kagaku Co., Ltd. Noccler DZ.

Further, the results of the durability of each rubber composition are shown in the following graphs.





Moreover, Table A disclosed in my declaration filed on October 8, 2009 and Table B disclosed in my declaration filed on January 13, 2010 are shown below again for the purpose of reference.

Table A

			Example 1	Example 2	Example 3	Additional Comparative Example A	Additional Comparative Example B	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5	Comparative Example 6
Formulation	Natural rubber (RSS#3)	parts by mass	90	75	50	97	35	90	75	50	-	-	100
	Polyisoprene rubber A *1		10	25	50	3	65	-	-	-	100	-	-
	Polyisoprene rubber B *2		-	-	-	-	-	10	25	50	-	100	-
	Carbon black *4		50	50	50	50	50	50	50	50	50	50	50
	Stearic acid		2	2	2	2	2	2	2	2	2	2	2
	Antioxidant 6C *5		1	1	1	1	1	1	1	1	1	1	1
	Zinc oxide		3	3	3	3	3	3	3	3	3	3	3
	Vulcanization accelerator DZ *6		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	Sulfur		1	1	1	1	1	1	1	1	1	1	1
Evaluation	Processability	index	112	121	138	102	140	108	109	115	143	126	100
	Wear resistance		101	99	99	101	97	99	97	93	97	85	100
	Durability		97	94	90	97	89	87	84	79	86	70	100

*1 Produced by the Production Example 1 of Polyisoprene described in paragraph [0028] in the specification of the present application, cis-1,4-bond content=99.6%, 3,4-bond content=0.4%, ML_{1+4} (100°C)=81.

*2 IR2200, made by JSR Corporation, cis-1,4-bond content=98.0%, 3,4-bond content=2.0%, ML_{1+4} (100°C)=82.

*4 N339, made by Tokai Carbon Co., Ltd. $N_2SA=93m^2/g$.

*5 N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine, made by Ohuchi Shinkou Kagaku Co., Ltd., Nocrac 6C.

*6 N,N'-dicyclohexyl-2-benzothiazolyl sulfenamide, made by Ohuchi Shinkou Kagaku Co., Ltd. Noccler DZ.

Table B

			Example 1	Additional Comparative Example C	Comparative Example 1	Example 2	Additional Comparative Example D	Comparative Example 2	Example 3	Additional Comparative Example E	Comparative Example 3	Comparative Example 6
Formulation	Natural rubber (RSS#3)	parts by mass	90	90	90	75	75	75	50	50	50	100
	Polyisoprene rubber A *1		10	-	-	25	-	-	50	-	-	-
	Polyisoprene rubber B *2		-	-	10	-	-	25	-	-	50	-
	Polyisoprene rubber C *3		-	10	-	-	25	-	-	50	-	-
	Carbon black *4		50	50	50	50	50	50	50	50	50	50
	Stearic acid		2	2	2	2	2	2	2	2	2	2
	Antioxidant 6C *5		1	1	1	1	1	1	1	1	1	1
	Zinc oxide		3	3	3	3	3	3	3	3	3	3
	Vulcanization accelerator DZ *6		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
	Sulfur		1	1	1	1	1	1	1	1	1	1
Evaluation	Processability	index	112	109	108	121	113	109	138	121	115	100
	Wear resistance		101	100	99	99	97	97	99	95	93	100
	Durability		97	90	87	94	87	84	90	82	79	100

*1 Produced by the Production Example 1 of Polyisoprene described in paragraph [0028] in the specification of the present application, cis-1,4-bond content=99.6%, 3,4-bond content=0.4%.

*2 IR2200, made by JSR Corporation, cis-1,4-bond content=98.0%, 3,4-bond content=2.0%.

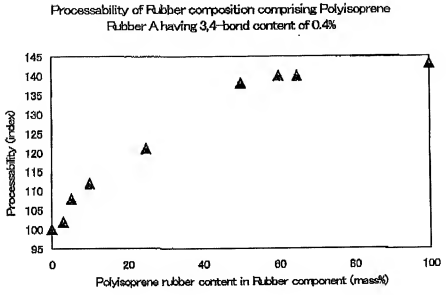
*3 Produced through the method described in my declaration filed on January 13, 2010, cis-1,4-bond content=99.3%, 3,4-bond content=0.7%.

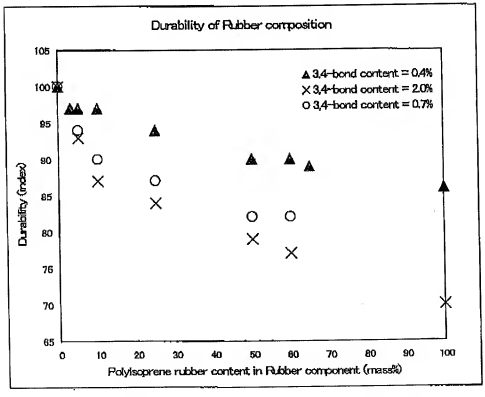
*4 N339, made by Tokai Carbon Co., Ltd. $N_2SA=93m^2/g$.

*5 N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine, made by Ohuchi Shinkou Kagaku Co., Ltd., Nocrac 6C.

*6 N,N'-dicyclohexyl-2-benzothiazolyl sulfenamide, made by Ohuchi Shinkou Kagaku Co., Ltd. Noccler DZ.

Furthermore, the above results shown in Tables A, B and C are summarized in the following graphs.





(Summary)

As seen from the results of the durability of the rubber composition, when the ratio of (A) the synthetic polyisoprene rubber to the total of (A) the synthetic polyisoprene rubber and (B) the natural rubber is 5-60 mass% but the 3,4-bond content of (A) the synthetic polyisoprene rubber exceeds 0.5%, the durability of the rubber composition is notably deteriorated.

Further, as seen from the results of the processability of the rubber composition comprising the Polyisoprene rubber A having a 3,4-bond content of 0.4%, the improvement in the processability is saturated when the ratio of (A) the synthetic polyisoprene rubber to the total of (A) the synthetic polyisoprene rubber and (B) the natural rubber is more than 60 mass%.

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: 4-13-2010 Declarant: Eiju Suzuki